Please add new claim 29 as follows:

-- 29. A semiconductor device according to claim 14, wherein the diffusion barrier is in direct contact with a lower surface of the first electrode. --

REMARKS

Entry of this amendment under the provisions of 37 C.F.R. 1.114, and reconsideration and allowance of this application, as amended, is respectfully requested.

This Amendment is response to the January 11, 2002 Office Action in this matter. Following the Office Action, and the filing of a Notice of Appeal on June 11, 2002, together with a Petition for Extension of Time, an interview was conducted with the Examiner in this case on October 31, 2002. Appreciation is expressed to Examiner Nguyen for his courtesy and helpfulness during the course of this interview. During the interview, the amending of claims 1 and 7 in the manner presented herein was discussed. After reviewing these proposed amendments, Examiner Nguyen indicated that these amendments raised new issues that would require a further search and further consideration since he had not previously considered these amendments (which will be discussed in detail below). Accordingly, Examiner Nguyen advised the undersigned attorney that these amendments could not be entered after final rejection. Therefore, the present RCE is being filed to obtain entry of these amendments and full consideration thereof, as well as amendments to claim 14, to be discussed below.

Reconsideration and allowance of claims 1 and 7, as amended, over the cited references to Fazan (USP 5,478,772) and Okudaira (USP 5,418,388) is respectfully

requested. Fig. 1 provides one example of an arrangement which claims 1 and 7 can be read on. In this arrangement, a ferroelectric capacitor is comprised of a lower electrode 61, a ferrolelectric film 71 and an upper electrode 72, with the ferroelectric film including at least one of lead, barium or bismuth. A reaction barrier film 43 is provided between the ferroelectric film 71 and an interlayer insulating film 32 over which the capacitor is formed. In addition, a diffusion barrier 51 (comprised, for example, of TiN) is formed under the lower electrode 61 and above a conductive plug 42 used for coupling the lower electrode 61 with a transistor region formed on the lower side of the interlayer insulating film 32. By virtue of the arrangement of the reactive barrier film 43 between the lower electrode 61 and the interlayer insulating film 32, as well as the separation of the side walls of the diffusion barrier 51 from the ferroelectric film 71 (by virtue of interposing the reaction barrier film 43 therebetween), both exfoliation of the ferroelectric film and an adverse reaction between the interlayer insulating film 32 and the ferroelectric film can be prevented (e.g., as discussed in the abstract of the invention and on page 7, lines 15-26 of the Substitute Specification).

Another feature of the arrangement of Fig. 1 is the fact that the upper surface of both the diffusion barrier 51 and the reaction barrier 43 are substantially on the same plane and both extend under the first electrode 61 of the capacitor. This coplanar relationship facilitates the avoidance of exfoliation of the ferroelectric film and prevention of the undesirable reaction between the interlayer insulator 32 and the ferroelectric film, as discussed above.

In the reference to Okudaira relied on in the Office Action for teaching a reaction barrier layer, the fundamental purpose is not to avoid an adverse reaction, but, instead, to improve adhesion between an interlayer insulating film and a

capacitor dielectric film, (as discussed in the last sentence of the abstract and on column 4, lines 35-40). For this purpose, an adhesion layer 11 is provided between the dielectric film 15 and the interlayer insulator 10, as shown in Fig. 1 of Okudaira. As set forth in column 9, line 47 et seq.:

> "In this first embodiment, the adhesion layer 11 is formed on the whole surface of the interlayer insulating film 10 as described above. Thereby, good adhesion can be obtained between the interlayer insulating film 10 and the high dielectric film 15. As a result, separation of the high dielectric film 15 from the interlayer insulating film 10, which may be caused in the prior art, can be effectively prevented, resulting in increase of the mechanical strength and reliability of the capacitor."

It is noted that the adhesion layer 11 is considered in the Office Action as equivalent to the reaction barrier defined in the present claims (e.g., see page 3, lines 1-3 of the Office Action), but this is not actually the reason for the use of this layer in Okudaira.

Okudaira also contains a diffusion barrier layer 13 which can be comprised, for example, of TiN. However, it is noted that the upper surface of this barrier layer 13 in Okudaira is formed above the adhesion layer 11, rather than on substantially the same plane. Therefore, Okudaira fails to teach or suggest the claimed feature of providing the diffusion barrier layer 13 in such a location as to have its upper surface substantially coplanar with the upper surface of a reaction barrier layer, even if one regards the adhesion layer 11 as such a reaction barrier layer.

The primary reference to Fazan teaches an arrangement in which an electrode 85 is formed over an interlayer insulator 40 and a conductive film 65 (for connecting the electrode to a transistor region) with a diffusion barrier 75 interposed between the electrode 85 and the conductive plug 65. The Office Action goes on to recognize that Fazan fails to teach any reaction barrier layer interposed between the interlayer insulating film and a ferroelectric film. However, the Office Action states

that it would be obvious to combine Okudaira with Fazan to utilize the adhesion layer 11 of Okudaira as a reaction barrier layer to meet the limitations of claims 1 and 7. However, in light of Okudaira's teaching of forming the barrier layer 13 over the adhesion layer 11, even if one were to combine Okudaira with Fazan, the adhesion layer 11 would be located above the insulator 40 rather than on the same level as the upper surface of the diffusion barrier 75 of Fazan. There is nothing in either reference to suggest that this combination would have the upper surface of a reaction barrier layer and the upper surface of the diffusion barrier layer on the same level. Clearly, Fazan fails to teach or suggest this since he has no teachings regarding a reaction barrier layer. Okudaira, on the other hand, teaches directly away from having the upper surface of a reaction barrier layer on the same plane as the upper surface of a diffusion barrier layer since its own diffusion barrier layer 13 is located to have its upper surface above the upper surface of the adhesion layer 11 which the Office Action equates to a reaction barrier layer. Therefore, it is respectfully submitted that amended claims 1 and 7 clearly define over the combination of Fazan and Okudaira, and reconsideration and removal of the rejection of these claims is respectfully requested.

Reconsideration and allowance of amended claim 14 is also respectfully requested. Claim 14 can be read on an arrangement such as shown, for example, in the third embodiment of Figs. 19-21 of the present application. In this arrangement, the diffusion barrier layer 192 is actually formed to extend completely through the interlayer insulating film 191 to act as the conductive connecting plug itself between the lower surface of the capacitor electrode 194 and a transistor region in the substrate. In conjunction with this, as shown in Fig. 21 and discussed on page 20, line 21-24 of the substitute specification, a reaction barrier film 211 is formed in self-

alignment with the lower capacitor electrode 194.

By virtue of the amendment to claim 14, the use of the diffusion barrier layer as the plug extending completely through the opening in the interlayer insulating film is clearly defined by the language:

> "a diffusion barrier layer provided in the opening portion to extend completely through the insulating film to form a plug, wherein said diffusion layer comprising said plug is connected to the transistor."

In conjunction with this, claim 14 has further been amended to define that:

> "said reaction barrier film is provided in self-alignment with said first electrode."

It is respectfully submitted that neither Fazan nor Okudaira teach or suggest any such arrangement. In the first place, neither Okudaira nor Fazan teach the use of a diffusion barrier layer extending completely through the insulating film to form the plug which is connected to the transistor. In addition, neither reference suggests the formation of the reaction barrier film in self-alignment with the first electrode, in combination with the recitation concerning the use of the diffusion barrier layer itself as the connecting plug. Therefore, it is urged that amended claim 14 also clearly defines over the combination of Fazan and Okudaira, and reconsideration and allowance of amended claim 14 is respectfully requested.

Reconsideration and allowance of the dependent claims 2-4, 8-11, 15-18 and new dependent claim 29 is also respectfully requested. These claims serve to define further distinctions of the invention over the cited prior art, particularly when considered in combination with the features of their respective parent independent claims. With regard to this, it is noted that the new dependent claim 29 specifically defines the direct contact of the diffusion barrier 192 with the lower surface of the

electrode 194, as shown in Fig. 21. As such, this further emphasizes the distinctions of the use of the diffusion barrier as a plug extending completely through an interlayer insulating film from the lower surface of a capacitor electrode 194 to electrically connect the capacitor electrode to a transistor region.

For the reasons set forth above, it is respectfully submitted that all of claims 1-4, 7-11, 14-18 and 29 define over the cited prior art, and reconsideration and allowance of these claims is respectfully requested.

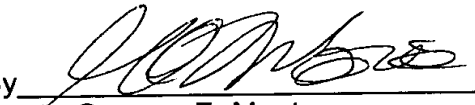
Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

If the Examiner believes that there are any other points which may be clarified or otherwise disposed of, either by telephone discussion or by personal interview, the Examiner is invited to contact applicants' undersigned attorney at the number indicated below.

To the extent necessary, the applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, Deposit Account No. 01-2135 (520.37546X00).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By 

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Attachments

## VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 1, 7 and 14 have been amended as follows:

1. (Amended) A semiconductor device comprising:

an insulating film formed on a substrate provided with a transistor and having an opening portion;

a conductive film formed in the opening portion; and

a capacitor formed on the conductive film and comprising a first electrode, a ferroelectric film and a second electrode;

wherein the [ferroelectrics] ferroelectric film includes at least one element selected from the group consisting of lead, barium and bismuth and formed from above the first electrode to above the insulating film;

wherein a reaction barrier film is provided between the insulating film and the ferroelectric film, said reaction barrier film being in contact with a lower surface of said first electrode such that the reaction barrier film is interposed between the lower surface of the first electrode and said insulating film;

wherein a diffusion barrier film is provided between the conductive film and the first electrode and side faces of the diffusion barrier are not brought into contact with the ferroelectric film; [and]

wherein an upper surface of said diffusion barrier film and an upper surface of said reaction barrier film are substantially on a same plane; and

wherein side faces of the first electrode are provided to be brought into contact with the ferroelectric film.

7. (Amended) A semiconductor device comprising:

a substrate provided with a transistor;

an insulating film formed on the substrate and having an opening portion;

a conductive film formed in the opening portion; and

a capacitor formed on the conductive film and comprising a first electrode; a ferroelectrics film and a second electrode;

wherein the ferroelectric film includes at least one element selected from the group consisting of lead, barium and bismuth and formed on an upper face and side faces of the first electrode and on the insulating film;

wherein a reaction barrier film is provided between the insulating film and the ferroelectric film, said reaction barrier film being in contact with a lower surface of said first electrode such that the reaction barrier film is interposed between the lower surface of the first electrode and said insulating film; [and]

wherein a diffusion barrier film is provided between the conductive film and the first electrode and in the opening portion of the reaction barrier film[.]; and

wherein an upper surface of said diffusion barrier film and an upper surface of said reaction barrier film are substantially on a same plane.

14. (Amended) A semiconductor device comprising:

a substrate having a transistor;

an insulating film formed on the substrate and having an opening portion extending completely through said insulating film;

a diffusion barrier [film] layer provided in the opening portion to extend completely through the insulating film to form a plug, wherein said diffusion barrier [film] layer comprising said plug is connected to the transistor;

a reaction barrier film provided on the insulating film;

a first electrode electrically [conducted] connected to the diffusion barrier [film] layer, wherein said reaction barrier film is provided in self-alignment with said first electrode;

a ferroelectric film provided on the first electrode and including at least one element selected from the group consisting of lead, barium and bismuth; and

a second electrode provided on the ferroelectric film.

New claim 29 has been added.